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Title : DEVELOPMENT OF A 3D EEG FEATURE EXTRACTION FOR BRAIN BALANCED INDEX (BBI) USING ARTIFICIAL NEURAL NETWORK (ANN)

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The thesis presents the development of a new three-dimensional (3D) EEG feature extraction for brain balanced index (BBI) using artificial neural network (ANN). There were five (5) indexes stated for BBI, index 1 (unbalanced condition), index 2 (less balanced), index 3 (moderately balanced), index 4 (balanced) and index 5 (highly balanced). There are four (4) sub-bands of frequency for EEG signals; δ band (0.2- 3 Hz), θ band (3- 8 Hz), α band (8-12 Hz) and β band (12-30 Hz). These sub-bands can be used to analyze human brain activities. This research involved 96 healthy subjects for EEG data collection. The EEG 3D signals are produced through signal processing and image processing techniques. The development of 3D involved preprocessing of raw EEG signals and construction of 2D EEG images or spectrograms. EEG signals are pre-processed using artifact removal and band pass filter technique. The resultant images for 2D EEG image are constructed via Short Time Fourier Transform (STFT). Power spectral density (PSD) values are extracted as features. Some techniques for data analysis like Shapiro-Wilk for data distribution analysis and Pearson correlation for data correlation analysis have been implemented. These features are analyzed to signify the pattern for brain balanced index. There are five (5) patterns found using mean relative power (MRP), difference mean relative power (DMRP), left-right slope (LR_Slope), mean relative power (MRP) ratio and difference mean relative power (DMRP) techniques. The results indicated that the proposed maximum PSD from the 3D EEG signal are able to distinguish the different levels of the brain balanced index. There are two classifiers involved for classification; *k*-Nearest Neighbor (*k*-NN) and Artificial Neural Network (ANN). The PSD values are chosen as input features to the classifier. There are 768 samples of data as inputs to classifiers. The number of training and testing ratio is assessed at 80% (615 samples) to 20% (153 samples) to find the best model based on percentage of accuracy, sensitivity, specificity as well as mean squared error (MSE). The ANN model produces overall classification accuracy of 88.89%, sensitivity within range 87.50% to 92.31% and specificity within range 94.92% to 98.82%. The classification accuracy using *k*-NN classifier is 84.96%. The sensitivity was obtained within range 83.33% to 88.88% and specificity within range 93.02% to 97.35%. The ANN model produces higher accuracy compared to *k*-NN.